IoT Will Not Deliver on Potential Without Solving This Challenge

Harry Sim

Lack of data visibility in existing plants hinders Industrial Internet of Things (IIoT) deployment, but noninvasive instrumentation upgrade is a key part of the solution.

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IIoT is a hot trend these days—it promises to revolutionize our industrial infrastructure by improving efficiency at existing power plants, refineries, off-shore oil platforms, pharmaceutical plants, hospitals, etc. According to McKinsey,[1] IIoT will unlock $6.2 trillion in potential economic impact by 2025. For the electricity sector alone, the World Economic Forum estimates $1.3 trillion of value can be captured with IIoT.

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But in some of the largest planned deployments of IIoT, the reality is more problematic. Most existing plants do not provide the data visibility IIoT needs; without that data, IIoT cannot work. Upgrading the plants to obtain the data can be extremely costly and also disruptive to operations, making the whole proposition economically unattractive.

Unless we can solve this challenge, Industrial IIoT will not fulfill its potential.

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WHAT IS THE INDUSTRIAL INTERNET OF THINGS?

Before we delve further, let's take a minute to recap what IIoT is.

In our everyday lives, we already experience an emerging Internet of Things. We have a proliferation of sensors and intelligence in our smartphones, our cars, our home thermostats, and even smart refrigerators. This rich source of sensor data can be networked, gathered, and analyzed by super smart software, which will help us to detect problems, work more productively, and save more energy. IIoT, or Industrial IoT, is the application of the same principles to industrial plants and processes. Gathering process data on pressures, temperatures, flow rates, RPM, vibration, and other measures will allow smart IIoT software to make plants more efficient, safer, and more reliable.

Virtually all the major industrial technology companies are rolling out IIoT offerings. Early on, IBM had Watson. GE has Predix. Schneider offers EcoStruxure. Honeywell announced Sentience. The majority of the current focus is on the *software* side of IIoT—databases and algorithms to crunch through terabytes of data to detect faults and optimize processes.

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CHALLENGE OF DATA VISIBILITY

But when it comes to real-life deployments at existing plants, software-driven efforts have encountered a huge hurdle. Those older, inef-

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ficient facilities, which are the prime targets for IIoT, were mostly built decades ago, before the advent of the internet and before digital-networked sensor technologies. There isn't sufficient data available to feed the sophisticated IIoT software.

Some of the largest IIoT efforts have already been stymied by this problem. Notably in November 2016, GE and Exelon announced the largest and most ambitious IIoT partnership in history, focusing on Exelon's fleet of power generation assets. Similarly, IBM and Areva (now Framatome) launched yet another effort in December 2017.

These programs included nuclear power plants (**Exhibit 1**), which involve complex processes and equipment and also high safety standards, making it an ideal opportunity for IIoT. This effort comes at a critical time for the nuclear industry—in 2016, the Nuclear Energy Institute set a target of 30 percent cost reduction within two years to ensure that nuclear power can compete with low-cost shale gas and even solar and wind-based generation. IIoT appeared to be the key to unlock these savings.

But even GE, which built and/or maintained many of the original reactors, and is arguably the best-positioned in the IIoT space, will run into huge challenges. Most of the US nuclear fleet is over 35 years old. When one walks into a typical plant, it is striking to see thousands of manual gauges, which are read by roving uniformed technicians (see **Exhibits 2** and **3**). These dial gauges, two to eight inches in diameter, use a needle to display pressure, flow, temperature, and other process data for feedwater systems, condensers, steam generators, and other components.

Plants must be retrofitted to enable the necessary digitization. But digitizing even one pressure gauge can be an intensive task that takes tens of thousands of dollars.

Ideally, this process data would be captured using digital sensors and available for IIoT applications, but this is not the case at virtually all existing nuclear plants. The plants must be retrofitted to enable the necessary digitization. But digitizing even one pressure gauge can be an intensive task that takes tens of thousands of dollars and months to accomplish.

The task involves detailed engineering design and assessment, which must be reviewed and ap-

Exhibit 1. Nuclear

Source: NRC.

Note: A typical nuclear power plant in the United States is over 35 years old, built before the availability of widespread digital sensors and networking.

proved by the Nuclear Regulatory Commission, plus actual installation work to cut pipes, install transducers, perform leak checks, run signal and power cables, and install input-output devices and controllers to collect the data. Moreover, the work can only be done when the unit involved is shut down, which means expensive disruption to plant operations. Using conventional approaches, there is no realistic way to perform the upgrade within the two-year time window set by the industry, and the huge upfront cost would take over a decade to pay back.

NONINVASIVE DIGITIZATION OF INSTRUMENTS

The only way to proceed is to look for alternative ways to retrofit manual instrumentation without the associated high cost and disruption.

This turns out to be the specialty of a technology startup company in Silicon Valley that developed a noninvasive, optical-based system (**Exhibit 4**). The Wireless Gauge Reader (WGR) from Cypress Envirosystems is essentially an "electronic eyeball" the size of a hockey puck, which can be attached to the face of an existing gauge in minutes without the need to cut any pipes or run any wires. Once attached, the WGR reads the gauge needle and converts that reading to a digital wireless value that can then be transmitted to a software application like GE's Predix. The devices can be installed in about 10 minutes each, with no shutdown or disruption to plant operations, and data is immediately visible using industry protocols such as OPC or RESTful API.

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At an average cost of $1,800 per gauge, the WGR is less than one-fifth the cost of using conventional instrumentation. The data provided by these devices help to detect faults to minimize unplanned downtime (e.g., pump and valve failures), reduce labor to manually log data, optimize the process efficiency for different operating scenarios, and enhance safety by lowering radiation exposure for workers. This technology is already installed at three nuclear power plants and a coal-fired plant at four utilities, and installation is pending at three more utilities.

In addition to dial gauges, noninvasive wireless-level indicator readers and analog vibration monitors are also available from Cypress Envirosystems and are similarly easy to install. Together, these solutions can quickly and cost-effectively digitize existing process data, and enable the huge savings promised by IIoT.

Exhibit 2. Manual Gauges

Courtesy Cypress Envirosystems.

Note: Thousands of manual gauges monitor critical parameters such as pressure, temperature, and flow; the readings are not digitized and do not lend themselves to IoT or fault detection analytics.

Exhibit 3. Data Reporting

Courtesy Cypress Envirosystems.

Note: Technicians read instruments manually and write on clipboards.

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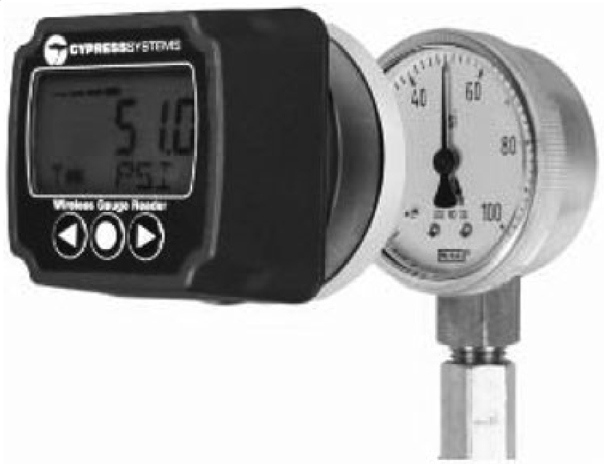
Exhibit 4. Electronic Eyeball



Courtesy Cypress Envirosystems.

Note: Noninvasive "Electronic Eyeball" Wireless Gauge Reader from Cypress Envirosystems—installs in minutes without breaking seals, running wires, or incurring process downtime.

INTEGRATION WITH PLANT NETWORK ARCHITECTURE

Once analog data is captured and digitized, an additional challenge is to collect and share it with different users and applications throughout the enterprise.

Plants should avoid unique point solutions from individual vendors, but instead implement a common and open networking standard that can accommodate multiple vendors and can scale to potentially tens of thousands of data points per site while addressing cybersecurity concerns.

EPRI has defined a roadmap for IoT connectivity for the electric power industry based on the LoRA wireless secure open standard. When paired with a plant wide Distributed Antenna System, this approach enables secure wireless access throughout the facility. Device contention and network security is managed by the LoRA protocol, which ensures that thousands of devices can coexist and communicate properly on the same network. The data from sensors is typically collected and stored on a historian such as OSI PI, which in turn may be queried and accessed by various users and application clients using industry standard protocols such as OPC or RESTful API.

Fortunately, noninvasive sensing devices such as the Wireless Gauge Reader are already compliant with this roadmap from EPRI. Cypress Envirosystems has worked closely with EPRI and Exelon to create and successfully deploy the first LoRA-based systems in operating power plants in the United States. This effort will ensure that the benefits of noninvasive instrumentation can be deployed broadly and can scale up and accommodate future needs.

APPLICABILITY TO A WIDE RANGE OF PLANTS

Of the 61 commercially operating nuclear plants in the United States, over half are older than 35 years, and virtually all of them are older than 20 years. The majority of them have manual instrumentation, which will hinder IIoT deployment. Many of these plants have been granted, or will apply for, license renewals that extend their operational life up to another 40 years, thus, it is imperative to find ways to improve efficiency for the long term.

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Beyond nuclear power, there are 141 refineries, over 7,500 conventional fossil fuel power plants, and over 13,500 chemical plants in the nation that share many of the same conditions. Improving efficiency at these brownfield sites not only is a business priority but also is critical for maintaining jobs and a healthy industrial base in the United States to compete with foreign greenfield plants.

Collectively, as McKinsey pointed out, these types of facilities represent trillions of dollars of potential savings ready to be unlocked by IIoT. But plants looking to implement IIoT must look beyond only software and networking to ensure success. Data visibility is clearly one of the key hurdles for the broad deployment of IIoT, and noninvasive approaches such as the Wireless Gauge Reader is a cost-effective way to upgrade and digitize their instrumentation.

NOTE

1. Manyika, J., Chui, M., Bisson, P., Woetzel, J., Dobbs, R., Bughin, J., & Aharon, D. (2015, June). *The internet of things: Mapping the value beyond the hype*. Retrieved from http://www.mckinsey.com/mgi.